

SPECIFICATION

RELEASE AGENT FOR METALLIC MOLD

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a release agent for ~~metallic mold~~ ^{metallic molds used for} forming plastic molded ~~product~~ ^{products}

2. Description of the Related Art

Plastics have excellent properties ^{productivity} such as easy processability, high ~~productivity~~ ^{costs}, light weight and relative low procuring ~~cost~~, so they are used for the parts and structural materials for ~~auto~~ ^{automobiles} ~~mobile~~, ^Sautobicycle, ^Sscooter, ^Stelevision, ^Sradio, ^Saudio equipment, ^Swashing machine, ^Srice cooker, ^Spersonal computer, ^Sportable telephone, ^Sgame machinery, ^Sbuilding ~~materials~~ ^{materials}, ~~office supplies~~, stationery, toys, sports goods, sports equipment, ~~agricultural~~ ^{agricultural} ~~tural~~ tools and marine tools.

They are usually prepared by plastic processing methods such as injection molding, blow molding, compression molding, transfer molding, rotating molding, slush molding, inflation tubular film ~~process~~, and extrusion molding. ^{processes} ^{processes,}

As plastics ~~processing~~ ^{temperatures} are conducted at high ~~temperature~~ above 200°C, additives,

^{colored} monomers, decomposed materials in the plastics are changed to carbonized ~~materials~~ ^{materials} such as tar, pitch and other ~~colored~~ ^{colored} sticky substances, which are apt to adhere to the ~~surface~~ ^{surface} of the screw, ~~bar~~ ^{surface}

~~barrel~~, die and metallic mold of the ~~plas-~~ plastic processing machine to cause transfer of the carbonized materials to the ~~mol~~ molded ~~product~~ products.

Above mentioned transfer ^{makes} the ~~sur~~ surfaces face of molded ~~product~~ ^{products} dirty and ^{makes} the dimensions of the molded product ~~un~~ inaccurate. ^{As a result the molded products do} ~~not~~ perform expected ~~moving~~ ^{required movement} or ~~structural~~ ^{functional} function. Therefore ~~clean~~ ^{cleaning} ing the screw, barrel, die and metallic mold of the plastic processing machine ~~machines~~ has been required.

In case of production ^{changes} ~~change~~ from ^{specific} ~~spe~~ cific ^{colored} ~~coloured~~ molded ^{articles} ~~article~~ to ^{noncolored} ~~noncol~~ oured or other ^{different colored} ~~coloured~~ molded ^{articles} ~~article~~, cleaning the screw, barrel and die has been ~~also~~ required to avoid cross ^{contamination} ~~cont~~ amination caused by ^{residual} ~~remained~~ ^{specifically} ~~specificat~~ ionally ^{colored} ~~coloured~~ resin compound ^{compositions} associated with

However, there are some problems ~~on the~~ ^{methods of} conventional ~~cleaning method~~ of the screw, barrel, die and metallic mold.

There are ~~some~~ problems ~~occurring at~~ ^{associated with} releasing the plastic molded ~~product~~ ^{products} from metallic ~~mold~~ ^{molds}.

The ~~metallic~~ ^{metallic} ~~mold~~ ^{molds used} for forming the ~~pla~~ ^{plastic} stic molded ~~product~~ ^{products} has the complicated ~~shape~~ ^{shapes} with fine hollow and convex parts.

Therefore, ~~the~~ plastic molded ~~product~~ ^{products} such as mechanical parts for electronic ~~device~~ ^{devices} and ~~automobile~~ ^{automobiles} have the complicated ~~shape~~ ^{shapes}. ^{Consequently} it is difficult to release the ~~plastic mold~~ ^{molded} ~~product~~ ^{products} from metallic ~~mold~~ ^{molds}, because both ~~surface~~ ^{surfaces} has ~~the~~ complicated contrasting ~~shape~~ ^{shapes}, which ~~causes~~ plastic mold ~~product~~ ^{products} ingrowing to

cause [↑] the ~~products~~ to ingrow into

portion of
the

and become anchored there to.

metallic mold as if anchor bites the
rock of bottom of the sea.

To avoid above mentioned difficulty of releasing both ^{surfaces} there ^{have} been ^{interface} efforts to treat conducted to give activity to the inter-
face between the metallic mold and the plastic molded product.

As ^{The} method for giving activity, the ^{of treating the interface involves}
using a ^{lubricant} ~~lubricant~~ has been conventionally used as ^a release agent for metallic mold.

The ^{lubricant} is usually applied by coating ^{it onto} the metallic mold ^{surfaces}.

However, when ^{that is} the metallic mold ^{is} coated by ^{with a} conventional release agent was ^{is} used for a long time, hard and uneven ^{heterogeneous} ~~terogeneous~~ layer ^{is} was formed ^{because of} by the following reasons.

One reason is, ^{the accumulation} accumulation of ~~the~~ resin and its additives such as antioxidant, metal deactivator, ^{an anti-ultraviolet} nucleating agent, ^{an} anti-ultraviolet ~~tiultraviolet~~ agent, antistatic agent, crosslinking agent, vulcanization agents and ~~lubricants~~ ^{lubricants}.

The other reason is, ^{the} accumulation of ~~the~~ decomposition materials of resin and its additives.

The uneven shape on the surface of ~~me~~ metallic mold ^{caused by the heterogeneous layer is} apt to be ^{transferred} transferred ^{to} on the surface of the plastic molded product together with ^{accumulated} and the accumulated contaminants ^{from} on the surface of the metallic mold ^{which will adhere} ~~are~~ adhered to the surface of the plastic molded product.

Above mentioned ^{transferring} transferring of shape ^{molded} makes the dimensions of the plastic ~~mol-~~ ded product ^{inaccurate} inaccurate not to perform ^{so that it will}

~~required movement~~ ~~structural~~ ~~functions~~
~~expected moving or structural function,~~
and adhering of ~~contaminants~~ makes the
surface of the plastic molded product
dirty.

The hard and uneven ~~heterogeneous~~ ^{heterogeneous} layer
on the surface of the metallic mold ~~fur~~ ^{surface}
~~face makes~~ ^{adversely affects the} releasing property, ~~wrong~~.

To remove the contaminants and ~~hetero-~~ ^{heterogeneous}
~~genous~~ layer ~~on~~ ^{from} the surface of the meta-
llic mold, it is ~~general way~~ ^{common} to wash the
soiled metallic mold after using ~~predet-~~ ^{a predetermined}
~~ermined time.~~ ^{time of use.}

At ~~the~~ ^a plastic molded product ~~maker,~~ ^{facility}
washing is ~~carried~~ ^{carried} out after ~~the~~ ^{the} troublesome
~~work~~ ^{task} of taking the soiled metallic mold
out from plastic processing machine, and
~~taking~~ ^{disassembling} the plastic mold ~~into~~ ^{into} pieces, which
requires ~~times~~ ^{time} and ~~labor~~ ^{labor} to ~~cause~~ ^{resulting in} heavy
loss ~~at~~ ^{of} efficiency and cost.

Especially ~~at~~ ^{for} complicated or large
~~size~~ ^{sized} metallic mold, ~~removing,~~ ^{molds} ~~dismantling~~ ^{dismantling}
and washing ~~work~~ are tremendous ~~to cause~~ ^{and}
~~obstacles~~ ^{obstacles} to improving the productivity
and ~~cost~~ ^{keeping} down.

To decrease the number of times of ~~the~~
metallic mold washing, a release agent
has been employed.

As the release agent, there ~~has~~ ^{have} been
~~known~~ ^{known} many types of ~~that~~ such as dimeth- dimethyl
yl polysiloxane of ~~the~~ ^{non-crosslinking} type,
paraffin wax, higher fatty acid ~~derivat-~~ ^{derivatives}
~~ive,~~ metal ~~soap,~~ ^{soaps,} talc, mica, and ~~polytet-~~ ^{polytetrafluoroethylene}
~~rafluoroethylene~~ of ~~the~~ ^{the} crosslinking type,
and the like.

However, conventional release agent ^{agents}
~~has been pointed out~~ ^{have} the following draw-

~~back. drawbacks.~~

In case ~~employing~~ ^{of employing a non-crosslinking} ~~non-crosslinking~~ type of release agent, the release agent ~~stay~~ ^{the} stays in ~~a specific place~~ ^{places} of the metallic mold so as to ~~affect~~ ^{adversely} influence ~~the~~ the plastic molded product.

In ~~the~~ ^a case ~~employing~~ ^{of} ~~a~~ crosslinking type of release agent, it ~~exhibits~~ ^{the release agent will exhibit an} ~~an excellent releasing~~ ^{releasing} property; however, ~~said~~ ^{the} release agent ~~is~~ ^{is} apt to adhere to the surface of a plastic molded product ~~so~~ ^{and} prevent the uniform painting or ~~an~~ ^{an} adhering treatment, resulting to decrease ~~post-processability~~ ^{post-processability}.

In case of requiring ~~a~~ ^a sufficient ~~releasing~~ ^{releasing} effect to achieve ~~a~~ ^a short shot cycle time, the amount of release agent must be increased, ~~resulting~~ ^{resulting} to ~~occur~~ ⁱⁿ the ~~accumulation~~ ^{accumulation} and degradation of the release agent on the metallic mold, which ~~bring~~ ^{This causes adversely} ~~bad influence~~ ^{adversely} to the smooth and gross properties and ~~the~~ ^{the} degradation of ~~the~~ ^{the} mechanical strength ~~such as~~ ^{including} tensile, elongate and ~~anti-impact~~ ^{anti-impact} strength.

Further, it has become ~~the~~ ^a problem that the release agent itself ~~has~~ ^{is} decomposed by the high temperature heat transfer from the metallic mold.

For instance, dimethyl polysiloxane oil ~~being~~ ^{which is a} representative release agent ~~has~~ ^{decomposes} ~~been~~ gradually decomposed over the ~~temperature~~ ^{temperature} of 150°C and ~~has been~~ rapidly ~~de~~ ^{decomposes} decomposed over the temperature of 200°C to form viscous gel-like ~~materials~~ ^{material}, which ~~has become the problem to degrade~~ ^{degrades} the releasing property.

For improving the heat-resistant ~~pro-~~

property of the ~~and~~ dimethyl polysiloxane, the use of
~~there has been proposed the amino-group~~
~~or mercapto-group modified dimethyl poly-~~
~~siloxane. polysiloxane has been proposed.~~ discovered that

However, ~~there~~ ^{it} has been detected the
~~problem that said modified dimethyl~~
~~polysiloxane has generated~~ ^{generates} bad smell
such as ~~ammonia gas~~ or mercaptan and ~~has~~
~~coloured the plastic molded product~~ ^{discolours} products.

Also, ~~dimethyl polysiloxane has been~~
~~detected its problem that the release~~ ^{a release}
agent using dimethyl polysiloxane must
~~has been~~ ^{be} prepared by dispersing it in
the water to form ~~the micelle~~ ^{micelles} by using a
surface active agent, because dimethyl
polysiloxane itself is not compatible
with water.

^A The release agent using ~~polytetrafluoroethylene~~ ^{polytetrafluoroethylene}
~~roethylene~~ has the drawback that it must
be baked onto the surface of metallic
mold. Therefore many troublesome ~~repeat~~ ^{repeated}
~~ing work~~ ^{steps} of baking must be conducted
notwithstanding its excellent releasing
effect and secondary processing ~~property~~ ^{properties}.

It is desirable that the release agent
for metallic ~~mold~~ ^{molds} ~~is~~ ^{be} prepared as ~~the an~~
emulsion type from viewpoint of cost, ^{applicability}
toxicity, ignition, handling and ~~applic-~~
~~ability~~.

Emulsion type ~~agent~~ ^{agents} ~~is~~ ^{are} prepared by ~~the~~ ^a
method ~~that~~ ^{in which a} surface active agent, water
and non-water-soluble dimethyl polysilo- ^{polysiloxane}
~~xane oil or wax oil~~ ^{are} ~~is~~ ^{together} agitated to form
~~micelle~~ ^{micelles}, which ~~is~~ ^{are} able to be ~~dispersed~~ ^{dispersed}
~~into~~ ⁱⁿ water.

However, above mentioned surface active

^{the}

~~agent~~ ^{agents react} with the ~~ingredients~~ ^{that bleed} ~~ed~~ from plastic molded ~~product~~ ^{products} to form ~~the~~ ^a strong membrane (coated layer) on the surface of the metallic mold.

The membrane (coated layer) ^{is} ~~has~~ hard and ^{has an} uneven heterogeneous shape. ~~there-~~ ^{which} ~~fore the shape~~ is trasfered ^{to} on the surf- ^{surface} ~~ace~~ of ~~the~~ plastic molded ~~product~~ ^{products} to ~~cause~~ ^{causing} the problem of ~~proeueing~~ ^{production of} the out of standard plastic molded ~~product~~ ^{products}.

On the other hand, when above mentioned release agent of ^{the} crosslinked type ~~is~~ ^{that requires} baking is used, the baked ~~membrane~~ ^{membrane} (coa- ^{coated} ~~ed~~ layer) ^{that exhibits} ~~of exhibiting~~ the releasing effect ~~has been~~ ^{is} gradually scraped ^{off} by the resin composition contacting ~~to~~ the metallic mold ^{at} ~~each~~ ^{during} injection shot.

As the above mentioned baked type ~~re-~~ ^{release} ~~lease~~ agent is gradually scraped ^{during} ~~at~~ each shot of plastic resin composition into metallic mold, the release agent is removed from the surface of metallic mold ^{after} ~~by~~ ^{repeating} shots from 10 to 20 ^{repeating shots are performed}.

^{fresh} ~~new~~ release agent must be applied onto the surface of metallic mold, which is a very troublesome ~~works~~ ^{task}.

Further ^{the} ~~above~~ mentioned baked type ~~re-~~ ^{release} ~~lease~~ agent has the other problem ~~owing~~ ^{of containing} to ~~containing~~ the reactive functional group such as amino, mercapto, isocyanate or vinyl group which is used for ~~condue-~~ ^{conducting} ~~ting~~ crosslinking and ^{the} ~~baking~~ reaction on the surface of metallic mold.

Owing to the reactive functional group, the surface energy of the ~~releasing~~ ^{release}.

agent layer on the metallic mold becomes very large to ^{an} increase ⁱⁿ the frictional force between the surface of the plastic molded product and the surface of ~~release~~ agent layer, which causes consumption of the release agent layer by scraping ~~by~~ ^{during} each injection shot, ~~resulting to limiting~~ ^{the} ~~restrict~~ the life of release agent layer ~~for the~~ ^{to} term of from 10 to 20 shots of injection mold. ^{material}

~~Short~~ ^{The short} life of the release agent ~~requires~~ ^{requires} ~~often~~ ^{more frequent application} of the release agent ~~by the~~ ^{by the} baking treatment, ~~which lead to accumu-~~ ^{accumulation} ~~lation of the unnecessary baked crossli-~~ ^{crosslinked} ~~nk~~ release agent on the surface of the metallic mold, which ^{adversely} ~~affects~~ ^{badly} ~~influences~~ ^{transfer} ~~such as~~ shape and contaminant ~~trans-~~ ^{fering} to the plastic molded product.

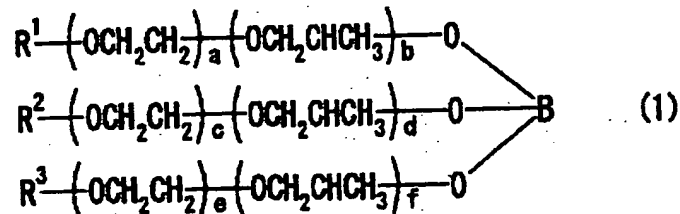
As mentioned above, conventional type release agent ^{agents have} ~~has the~~ ^{drawbacks} such as poor release effect, short durability term, difficult secondary processability and difficult ^{application} ~~treatment~~ (baking) ~~work on-~~ ^{onto} to the metallic mold.

SUMMARY OF THE INVENTION

As a result of diligent investigation ~~by~~ ^{during the course of} the present invention, ~~under such sit-~~ ^{uation}, the present invention provides a release agent for metallic ^{molds used} ~~mold~~ for ^{forming} ~~forming~~ a plastic molded product ~~character-~~ ^{products which release agents} ~~ized by containing~~ ^{contain} a borate ester of a polyoxyalkylene.

DETAILED DESCRIPTION OF THE INVENTION

A borate ester of polyoxyalkylene used for the present invention is a chemical compound expressed by the following general formula (1).

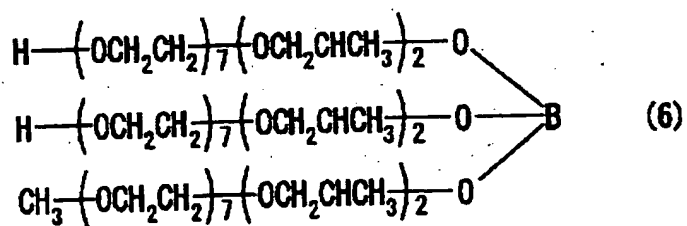
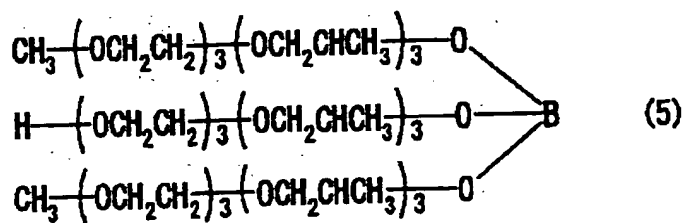
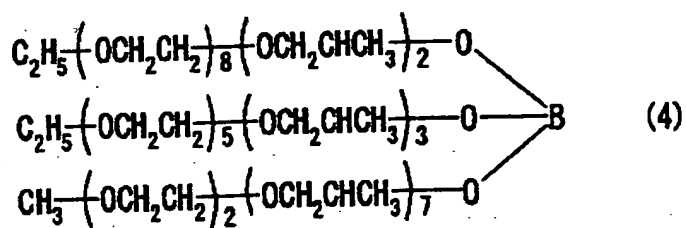
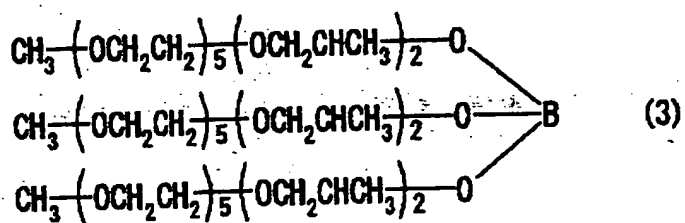
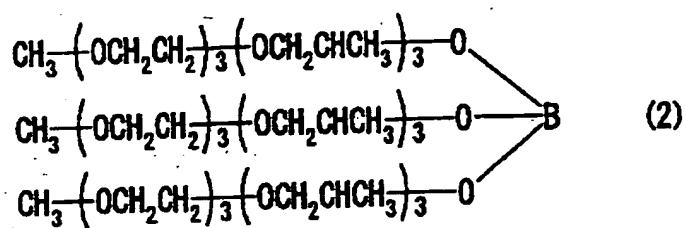


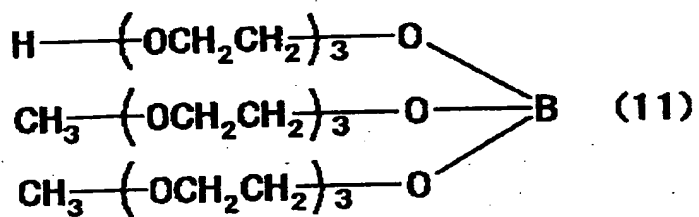
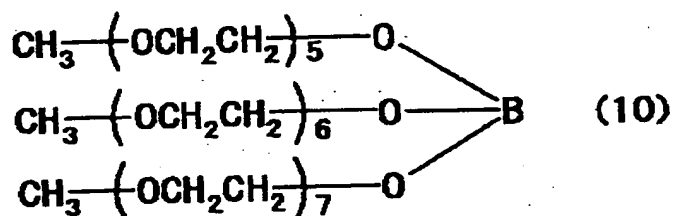
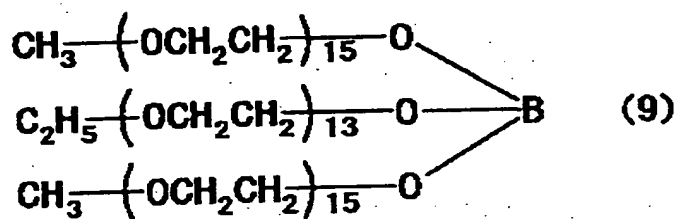
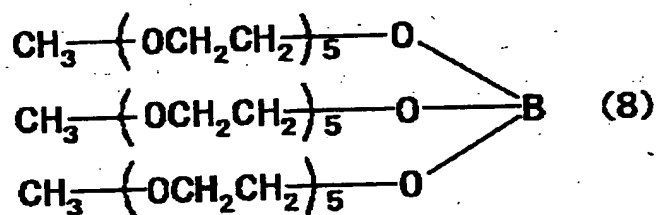
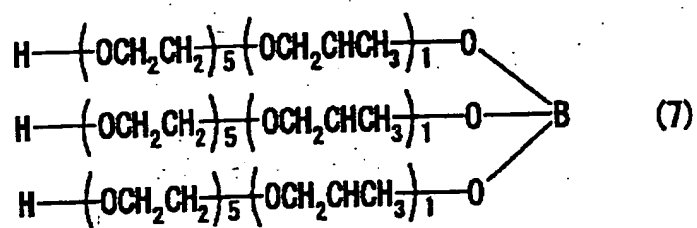
wherein R^1 , R^2 and R^3 are independently selected from ~~the~~ ^{a hydrocarbon group} group consisting of ~~hydro-~~ ^{hydrocarbon} ~~hydrogen~~ ~~and hydrocarbon group~~ ^{hydrocarbon groups}, a, b, c, d, e and f are positive integers independently ~~selected~~ ^{selected} from 0 ~~to 30~~ ^{to 30} whose sum is from 6 to 80.

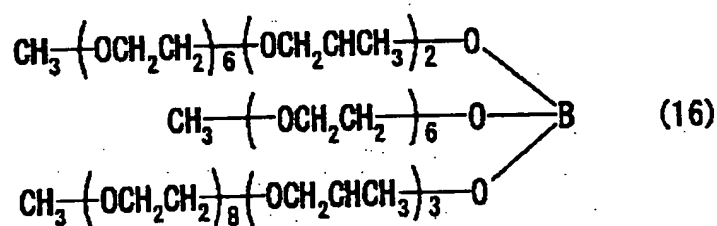
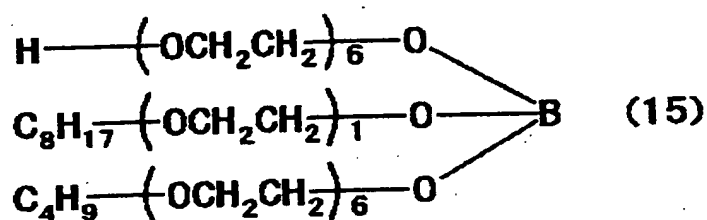
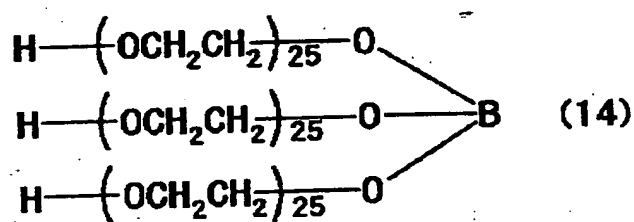
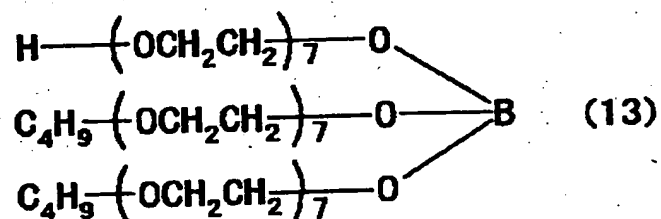
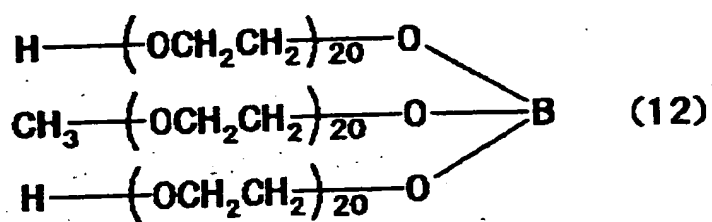
from 0 to 30 whose sum is from 0 to 30.

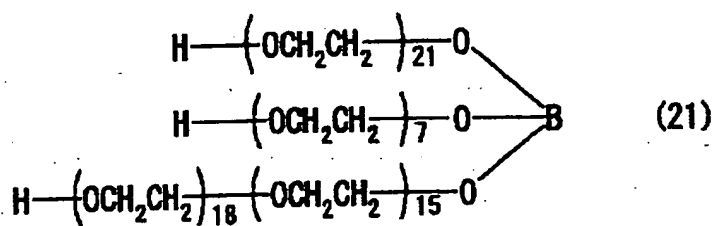
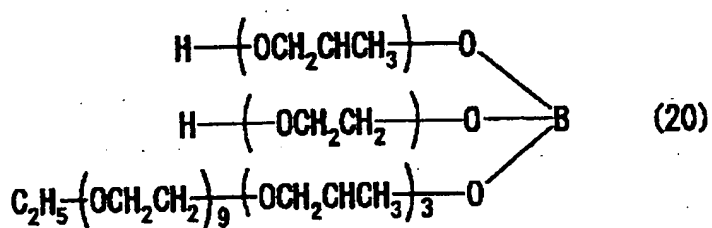
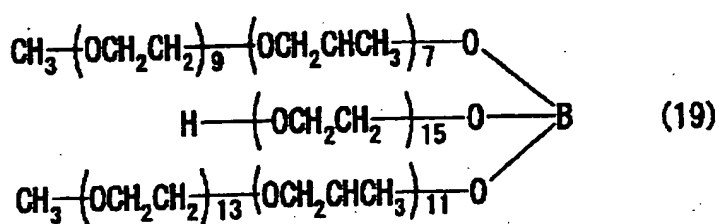
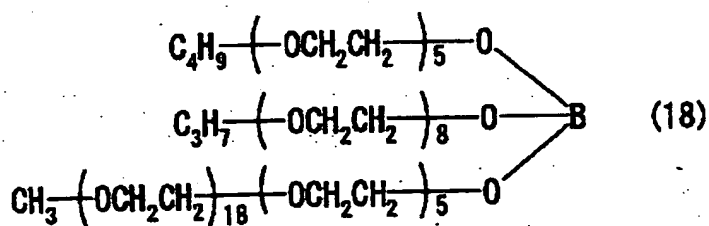
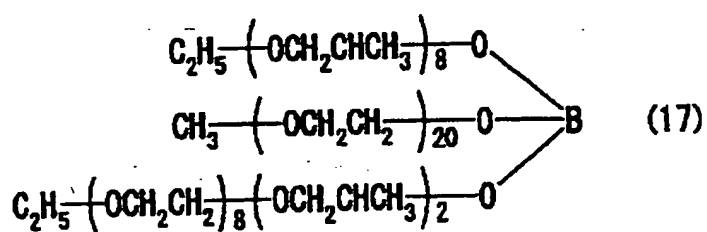
~~Example~~ ^{hydrocarbon} groups are alkyl groups such as methyl, ethyl, ~~pro~~-propyl, ~~pyl~~, isopropyl, ~~butyl~~, ~~pentyl~~, hexyl, ~~octyl~~, nonyl, decyl, dodecyl, hexadecyl, octadecyl and docosyl groups and phenyl, tolyl and cyclohexyl ~~group~~ ^{groups} _{etc.}

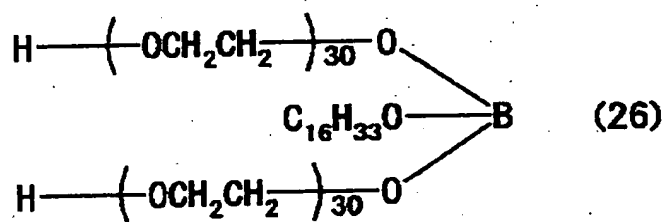
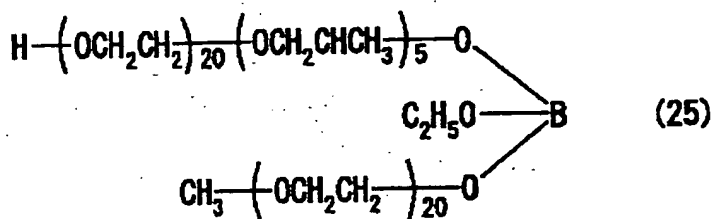
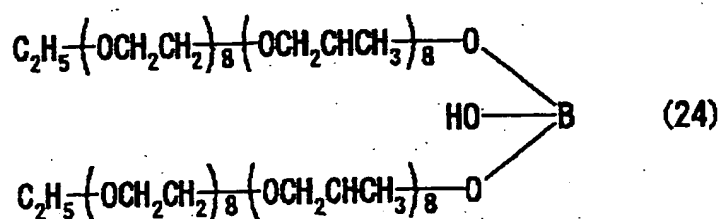
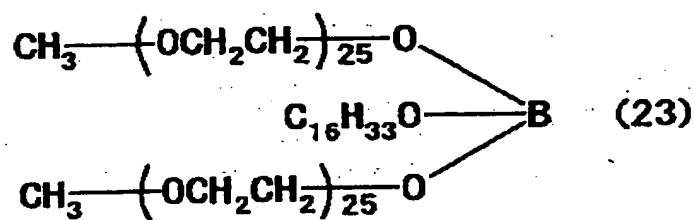
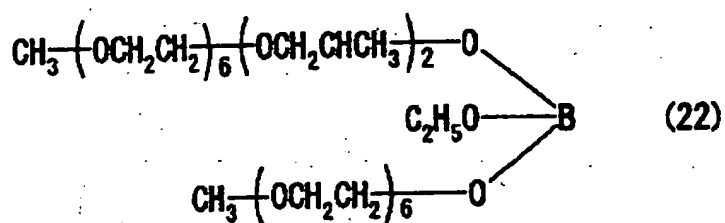
Illustrative of the borate ~~ester~~^{esters} of polyoxyalkylene are the chemical ~~compound~~^{compounds} expressed by the following chemical formula from (2) to (27).

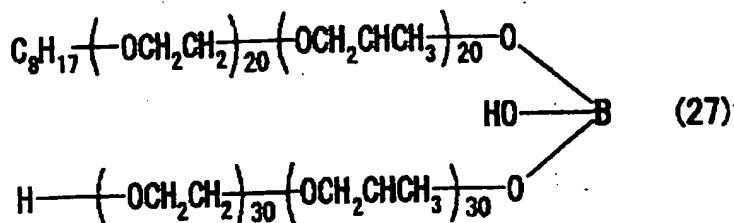












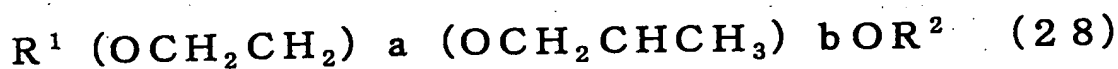
Production ~~method~~ ^{methods making the} for borate esters of polyoxyalkylene used for ~~the~~ ^{the} present invention are not limited to ~~any~~ ^{any} specific method; ~~but~~ ^{however, the} following method is ~~prefer-~~ ^{preferred} able.

The borate esters of polyoxyalkylene are produced by ~~esterification - dehydration~~ ^{esterification} or ~~ester exchange~~ ^{ester exchange} reaction by ~~contacting~~ ^{contacting} a polyoxyalkylene expressed by the chemical formula (28) with ~~boric acid or borate esters of lower alcohol~~ ^{all alcohols} such as methyl alcohol or ethyl alcohol.

It is ~~preferable~~ ^{preferred} that ~~the~~ ^{the} reaction is ~~car-~~ ^{be carried} ried out ~~by~~ using 1 mol of boric acid or borate esters of lower ~~alcohol~~ ^{alcohols} with from 3 to 3.5 moles of polyoxyalkylene ~~expre-~~ ^{expressed} ssed by the chemical ~~formula~~ ^{formula} (28).

If the mole ratio is less than 3, ~~it is not preferable because~~ ^{it is not preferable because} undesirable byproducts of borate esters having two or three boron atoms are generated.

~~The other~~ ^{other} byproducts or unreacted ~~polyoxyalkylene~~ ^{polyoxyalkylene} may ~~be~~ ^{remain} remained in the borate esters unless they do not hinder the purging effect of the resin composition of the present invention.



wherein R^1 and R^2 are independently ~~selected~~ ^{selected} from ^a group consisting of hydrogen and hydrocarbon group, a and b are ~~independently~~ ^{independently} ~~selected~~ ^{selected} from 0 to 30.

~~Example~~ ^{Examples} of the hydrocarbon group are alkyl groups such as methyl, ethyl, propyl, isopropyl, ~~butyl~~ ^{butyl}, pentyl, hexyl, octyl, nonyl, decyl, dodecyl, hexadecyl, ~~octa-~~ ^{octadecyl} ~~deyl~~ and docosyl groups and phenyl, ~~to~~ ^{tolyl} ~~yl~~ and cyclohexyl groups.

~~Example~~ ^{Examples} of the polyoxyalkylene ~~expressed~~ ^{expressed} by the chemical formula (28) are as follows.

diethylene glycol monomethyl ether,
diethylene glycol monoethyl ether,
diethylene glycol monoisopropyl ether,
diethylene glycol ~~monobutyl~~ ^{monobutyl} ether,
diethylene glycol ~~monooctyl~~ ^{monooctyl} ether,
diethylene glycol monodecyl ether,
diethylene glycol monohexadecyl ether,
diethylene glycol monooctadecyl ether,
triethylene glycol monomethyl ether,
triethylene glycol monoethyl ether,
triethylene glycol monoisopropyl ether,
triethylene glycol ~~monobutyl~~ ^{monobutyl} ether,
triethylene glycol ~~monobutyl~~ ^{monobutyl} ether,
triethylene glycol ~~monooctyl~~ ^{monooctyl} ether,
triethylene glycol monodecyl ether,
triethylene glycol monohexadecyl ether,
triethylene glycol monooctadecyl ether,

tetraethylene glycol monomethyl ether,
tetraethylene glycol monoethyl ether,
tetraethylene glycol monoisopropyl ether,
tetraethylene glycol ~~monobutyl~~ ^{monobutyl} ether,
tetraethylene glycol ~~monooctyl~~ ^{monooctyl} ether,

tetraethylene glycol monodecyl ether,
tetraethylene glycol monohexadecyl ether,
tetraethylene glycol monooctadecyl ether,

polyethylene glycol monomethyl ether,
polyethylene glycol monoethyl ether,
polyethylene glycol monoisopropyl ether,
polyethylene glycol ~~monobutyl~~ ether,
polyethylene glycol ~~monooctyl~~ ether,
polyethylene glycol monodecyl ether,
polyethylene glycol monohexadecyl ether,
polyethylene glycol monooctadecyl ether,

dipropylene glycol monomethyl ether,
dipropylene glycol monoethyl ether,
dipropylene glycol monoisopropyl ether,
dipropylene glycol ~~monobutyl~~ ether,
dipropylene glycol ~~monooctyl~~ ether,
dipropylene glycol monodecyl ether,
dipropylene glycol monohexadecyl ether,
dipropylene glycol monooctadecyl ether,

tripropylene glycol monomethyl ether,
tripropylene glycol monoethyl ether,
tripropylene glycol monoisopropyl ether,
tripropylene glycol ~~monobutyl~~ ether,
tripropylene glycol ~~monooctyl~~ ether,
tripropylene glycol monodecyl ether,
tripropylene glycol monohexadecyl ether,
tripropylene glycol monooctadecyl ether,

tetrapropylene glycol monomethyl ether,
tetrapropylene glycol monoethyl ether,
tetrapropylene glycol monoisopropylether,
tetrapropylene glycol ~~monobutyl~~ ether,
tetrapropylene glycol ~~monooctyl~~ ether,

tetrapropylene glycol monodecyl ether,
tetrapropylene glycol monoheptadecylether,
tetrapropylene glycol monooctadecylether,

polypropylene glycol monomethyl ether,
polypropylene glycol monoethyl ether,
polypropylene glycol monoisopropyl ether,
polypropylene glycol ~~monobuthyl~~ ether,
polypropylene glycol ~~monooethyl~~ ether,
polypropylene glycol monodecyl ether,
polypropylene glycol monoheptadecyl ether,
polypropylene glycol monooctadecyl ether,

diethyleneglycol tripropyleneglycol
monomethyl ether,
tetraethyleneglycol dipropyleneglycol
monomethyl ~~methers~~ ether,
tetraethyleneglycol tripropyleneglycol
monomethyl ether,
tetraethyleneglycol tetrapropyleneglycol
monomethyl ether,
pentaethyleneglycol dipropyleneglycol
monomethyl ether,
pentaethyleneglycol tripropyleneglycol
monomethyl ether,
diethyleneglycol tetrapropyleneglycol
monomethyl ether,

hexaethyleneglycol dipropyleneglycol
monomethyl ether,
hexaethyleneglycol dipropyleneglycol
monomethyl ~~methers~~ ether,
hexaethyleneglycol tripropyleneglycol
monomethyl ether,
hexaethyleneglycol tetrapropyleneglycol
monomethyl ether,

hexaethyleneglycol pentapropyleneglycol
monomethyl ether,
hexaethyleneglycol hexapropyleneglycol
monomethyl ether,

heptaethyleneglycol dipropyleneglycol
monomethyl ether,
heptaethyleneglycol dipropyleneglycol
monomethyl ~~ether~~ ether,
heptaethyleneglycol tripropyleneglycol
monomethyl ether,
heptaethyleneglycol tetrapropyleneglycol
monomethyl ether,
heptaethyleneglycol pentapropyleneglycol
monomethyl ether,
heptaaethyleneglycol hexapropyleneglycol
monomethyl ether, *heptapropyleneglycol*
heptapropyleneglycol ~~heptapropylenegly-~~
~~col~~ monomethyl ether,

octaethyleneglycol dipropyleneglycol
monomethyl ether,
octaethyleneglycol tripropyleneglycol
monomethyl ~~ether~~ ether,
octaethyleneglycol tetrapropyleneglycol
monomethyl ether,
octaethyleneglycol pentapropyleneglycol
monomethyl ether,
octaethyleneglycol hexapropyleneglycol
monomethyl ether,
octaethyleneglycol heptapropyleneglycol
monomethyl ether,
polyethyleneglycol polypropyleneglycol
monomethyl ether,

triethylene glycol ,

tetraethylene glycol, ✓
pentaethylene glycol, ✓
hexaethylene glycol, ✓
heptaethylene glycol, ✓
octaethylene glycol, ✓
decaethylene glycol, ✓
tridecaethylene glycol, ✓
hexadecaethylene glycol, ✓
eicosaethylene glycol, ✓
pentacosaethylene glycol, ✓
triacosaethylene glycol, ✓

tripropylene glycol, ✓
tetrapropylene glycol, ✓
pentapropylene glycol, ✓
hexapropylene glycol, ✓
heptapropylene glycol, ✓
octapropylene glycol, ✓
decapropylene glycol, ✓
tridecapropylene glycol, ✓
hexadecapropylene glycol, ✓
eicosapropylene glycol, ✓
pentacosapropylene glycol, ✓
triacosapropylene glycol, ✓

triethylene glycol tripropylene glycol,
tetraethylene glycol dipropylene glycol,
tetraethylene glycol tripropylene glycol,
tetraethylene glycol tetrapropylene
glycol,
pentaethylene glycol dipropylene glycol,
pentaethylene glycol tripropylene glycol,
hexaethylene glycol dipropylene glycol,
hexaethylene glycol tripropylene glycol,
hexaethylene glycol pentapropylene
glycol,

hexaethylene glycol hexapropylene glycol,
heptaethylene glycol dipropylene glycol,
triaosaethylene glycol dipropylene
glycol,

heptaethylene glycol tripropylene glycol,
heptaethylene glycol tetrapropylene
glycol,

heptaethylene glycol pentapropylene
glycol,

heptaethylene glycol hexapropylene
glycol,

heptaethylene glycol heptapropylene
glycol,

octaethylene glycol dipropylene glycol,
octaethylene glycol tripropylene glycol,
octaethylene glycol tetrapropylene
glycol,

octaethylene glycol pentapropylene
glycol,

octaethylene glycol hexapropylene glycol,
octaethylene glycol pentapropylene
glycol,

octaethylene glycol octapropylene glycol,
polyethylene glycol polypropylene glycol,

tripropylene glycol triethylene glycol
monomethyl ether,

tetrapropylene glycol diethylene glycol
monomethyl ether,

tetrapropylene glycol triethylene glycol
monomethyl ether,

tetrapropylene glycol tetraethylene
glycol monomethyl ether,

pentapropylene glycol diethylene glycol

monomethyl ether,
pentapropylene glycol triethylene glycol
monomethyl ether,
pentapropylene glycol tetraethylene
glycol monomethyl ether,

hexapropylene glycol diethylene glycol
monomethyl ether,
hexapropylene glycol triethylene glycol
monomethyl ether,
hexapropylene glycol tetraethylene
glycol monomethyl ether,
hexapropylene glycol pentaethylene
glycol monomethyl ether,
hexapropylene glycol hexaethylene glycol
monomethyl ether,

heptapropylene glycol diethylene glycol
monomethyl ether,
heptapropylene glycol triethylene glycol
monomethyl ether,
heptapropylene glycol tetraethylene
glycol monomethyl ether,
heptapropylene glycol pentaethylene
glycol monomethyl ether,
heptapropylene glycol hexaethylene
glycol monomethyl ether,
heptapropylene glycol heptaethylene
glycol monomethyl ether

octapropylene glycol diethylene glycol
monomethyl ether,
octapropylene glycol triethylene glycol
monomethyl ether,
octapropylene glycol tetraethylene
glycol monomethyl ether,

octapropylene glycol pentaethylene
glycol monomethyl ether,
octapropylene glycol hexaethylene glycol
monomethyl ether,
octapropylene glycol heptaethylene
glycol monomethyl ether
octapropylene glycol octaethylene glycol
monomethyl ether
polypropylene glycol polyethylene glycol
monomethyl ether

tripropylene glycol triethylene glycol
monomethyl ether,
tetrapropylene glycol triethylene glycol
monomethyl ether,
tripropylene glycol triethylene glycol
monomethyl ether,
octapropylene glycol diethylene glycol
monomethyl ether,

octaethylene glycol dipropylene glycol
monomethyl ether,
octaethylene glycol tripropylene glycol
monomethyl ether,
octaethylene glycol tetrapropylene
glycol monomethyl ether,
octaethylene glycol pentapropylene
glycol monomethyl ether,
octaethylene glycol hexapropylene glycol
monomethyl ether,
octaethylene glycol heptapropylene
glycol monomethyl ether,
octaethylene glycol octapropylene glycol
monomethyl ether,
polyethylene glycol polypropylene glycol
monomethyl ether.

A solvent or diluent may be ^{incorporated} ~~incorporated~~ into the raw materials such as boric acid, borate ester of lower alcohol and polyoxyalkylene, or into ^{the} borate esters of polyoxyalkylene.

If ^a ~~the~~ solvent or diluent are employed, they must not disturb the esteryfication-dehydration or ester-exchange reaction and their boiling ^{points should preferably} ~~point are preferable~~ ^{below} be ~~below~~ the boiling point of the ~~by products~~ ^{by products} or polyoxyalkylenes.

^{Examples} ~~Example~~ of ~~the~~ solvents or diluents are ethers such as diethyl ether, dioxane, tetrahydrofran; aliphatic hydrocarbons such as hexane, acetic anhydride, heptane, octane, nonane, decane, undecane; ~~aroma~~ ^{aromatic} ~~tie~~ hydrocarbons such as benzene, ~~tolu~~ ^{toluene} ~~ene~~, xylene; ~~cycloalkanes~~ ^{cycloalkanes} such as ~~cyclo~~ ^{cyclohexane} ~~hexane~~, cyclohexene; non-proton polar ~~compounds~~ ^{compounds} such as dimethy formamide, di- ^{dimethyl} ~~methy~~ sulfoxide, hexamethyl polyamide phosphate, acetonitrile, N-methyl ~~pyrro~~ ^{pyrrolidone} ~~lidone~~, and their chlorine substituted ~~compound~~ ^{compounds} such as chloroform and carbon tetrachloride.

A ~~catalysts~~ ^{catalyst} for the esteryfication-dehydration or ester-exchange reaction may be used.

If ~~the~~ ^{catalyst is} ~~catalysts~~ are necessary for ^{condensation} ~~condensation~~ promoting the reaction, following ~~condensation~~ catalysts are recommended.

^{Examples} ~~Example~~ of the ~~catalysts~~ ^{catalyst} are metallic ~~salt~~ ^{salts} of organic ~~acid~~ ^{acids} such as ferrous ~~oo~~ ^{octanoate} ~~tanoate~~, ferrous naphthenate, cobaltous naphthenate, manganese octanoate, ~~stann~~ ^{stannum} ~~um~~ octanoate, stannum naphthenate, lead

octanoate, lead naphthenate, organotin ^{compounds} ~~compound~~ such as ^{dibutyl} ~~dibutyl~~ tin diacetate, ^{dibutyl} ~~dibutyl~~ tin dioctanoate, ^{dibutyl} ~~dibutyl~~ tin dilaurate, ^{dibutyl} ~~dibutyl~~ tin dioleate, ^{dibutyl} ~~dibutyl~~ tin dimethoxide, oxidized ^{dibutyl} ~~dibutyl~~ tin; metal ^{alcoholates} ~~alcoholate~~ such as tetrabutyl ~~ti~~ ^{titumate} ~~tanate~~, tetrabutyl zirconate; titanium ^{chelates} ~~chelate~~ such as di-isopropoxy bis-acetyl acetate titanium, 1, 3-propanedioxy ^{3-propanedioxy} ~~3-propanedioxy~~ bis-ethylacetate titanium, 1, 3-propanedioxy bis-ethylacetate titanium; ^{aluminum chelates} ~~aluminum chelate~~ such as ^{aluminum} ~~aluminum~~ acetyl acetate, ^{aluminum} ~~aluminum~~ tris-ethylacetate ^{acetate} ~~acetate~~; amines such as hexyl amine, ~~dodecylamine~~ ^{dodecylamine} ~~eylamine~~ phosphate, dimethyl hydroxy ~~hydroxyamine~~ ^{hydroxyamine} ~~amine~~, diethyl hydroxyamine; tetra ~~ammonium~~ ^{ammonium} ~~ammonium~~ ^{salts} ~~salt~~ such as benzyl hydroxyamine; inorganic ^{acids} ~~acid~~ such as ^{hydrochloric} ~~hydrochloric~~ acid, nitric acid, ^{sulfuric} ~~sulfuric~~ acid, phosphoric acid; organic ^{acids} ~~acid~~ such as acetic ^{anhydride} ~~anhydride~~, pure acetic acid (over 99.8%), ^{propionic} ~~propionic~~ acid, citric acid, benzoic acid, ^{formic} ~~formic~~ acid, acetic acid, oxalic acid, p-toluenesulfonic acid; ~~chlorosilanes~~ ^{chlorosilanes} such as methyl trichlorosilane, dimethyl dichlorosilane; inorganic ^{bases} ~~base~~ such as aqueous ammonia; organic ^{bases} ~~base~~ such as ethylene diamine, triethanol amine; and amino alkylamine.

It is preferable that the ^{esterification-dehydration} ~~esterification~~ ^{reaction} ~~reaction~~ or ester exchange ^{reaction} ~~reaction~~ is carried out under the ~~condition~~ of at reduced or atmospheric pressure, ^{and at a temperature of} ~~and at a temperature of~~ from 80 to 250°C ^{temperature, favourably} ~~temperature, favourably~~ from 100 to 180°C. ^{and preferably}

During the reaction, removal of ~~by-product~~ ^{by products}

ducts such as lower ^{alcohols} alcohol or water can ^{precede} proceed the reaction easily because ^{precede} removal of byproducts ^{the formation} precede the reaction equilibrium to favorable ^{esters} direction of borate ester of polyoxyalkylenes, ~~formation.~~

As to the removal method, azeotropic distillation using azeotropic ^{agents} agent and batch or continuous distillation using distillation ^{towers} tower are ~~preferable.~~ ^{preferred}

For the purpose of improving the ~~properties~~ ^{properties} of the borate ester of ~~polyoxy-alkylenes~~ ^{polyoxyalkylenes} amino-group containing ~~compounds~~ ^{compounds} and and/or ~~solvent~~ ^{solvents} may be added to said the borate esters of polyoxyalkylenes.

Adding the amino-group containing ^{compounds} compound to the borate ester of ~~polyoxy-alkylenes~~ ^{polyoxyalkylenes} ~~exhibits~~ ^{causes} the ~~suppressing~~ ^{suppression} of borate ester hydrolysis and also ~~exhibits~~ ^{improves} rust preventive ~~effects~~ ^{effects} ~~under the condition of existence~~ ^{caused by the} of water or its vapor.

Examples of the amino-group containing ^{compounds} compound include alkylamine, cyclo alkyl amine, alkanol amine, heterocyclic amine, diamine, lactam, cyclic imide and ~~poly-~~ ^{polyamine} amine, which may be used alone or ~~combination~~ ^{combination} ~~selecting from these compound.~~

As the alkyl amine, there can be used methyl amine, dimethyl amine, trimethyl amine, ethyl amine, diethyl amine, ~~tri-~~ ^{triethyl} ethyl amine, propyl amine, N, N-di-~~[poly~~ ^{[poly(4)} N, N-di-~~[poly(4)~~ ^{oxyethyl]} hexadecyl amine, dodecyl dimethyl amine, stearamide propyl ~~dime-~~ ^{dimethyl} ~~thyl~~ amine, polyoxyethylene (3-30) ~~octa-~~ ^{octadecyl} ~~deceyl~~ amine, polyoxyethylene (3-30) lauryl

amine, polyoxyethylene (3-30) oleyl amine, polyoxyethylene (3-30) dilauryl amine, polyoxyethylene (3-30) stearyl amine, polyoxyethylene (3-30) alkyl amine, ~~poly-~~ polyoxyethylene (3-30) ~~oxyethylene~~ (3-30) dialkyl amine, and di (oleoyloxyethyl) hydroxy amine.

As the cycloalkyl amine, there can be used cyclohexyl amine, methyl cyclohexyl amine and ethyl cyclohexyl amine.

As the alkanol amine, there can be used ethanol amine, diethyl hydroxy methyl amine, diethanol amine, dimethyl ~~amino-~~ aminocethanol ethanol, triethanol amine, propanolamine, dimethyl 2-hydroxypropyl amine, butanol amine, methyl di (2-hydroxyethyl) amine, tri (2-hydroxyethyl) amine, hydroxymethyl di (2-hydroxyethyl) amine, dibenzyl 2-hydroxypropyl amine and cyclohexyl di (2-hydroxyethyl) amine.

As the cycloalkanol amine, there can be used cyclohexanol amine, ~~methylcyclohexanol~~ methylcyclohexanol ~~hexanol~~ amine and ethylcyclohexanol amine.

As the heterocyclic amine, there can be used ~~used~~ pyridine, lutidine, 3, 4-xylidine, piperidine, N-methyl piperidine and N-ethyl piperidine.

As the lactam, there can be used propio lactam, N-methylpropio lactam, N-ethyl ~~butylo~~ butylo lactam, N-methyl varero lactam, N-methyl caprolactam and phenyl caprolactam.

As the cyclic imide, there can be used succinimide, N-methyl succinimide, ~~N~~ N-ethyl ~~ethyl~~ succinimide, phenyl succinimide and 2-undecyl imidazoline.

As the diamine, there can be used ethylene diamine, triethylene diamine and tetraethylene diamine.

As the polyamine, there can be used diethylene triamine, triethylene ~~tetra~~ tetramine ~~mine~~ and pentaethylene pentamine.

Among these ~~amino-group~~ ^{amino-group} containing ~~com-~~ ^{compounds} ~~pound,~~ tertiary ~~amino-group~~ ^{amino-group} containing compounds exhibit ^{an} excellent ^{or} effect of preventing hydrolysis of borate ester of polyoxyalkylene and ~~promoting~~ ^{promote} the ~~clea-~~ ^{cleaning} ~~ning~~ and purging the ~~coloured~~ ^{colored} ~~contamina-~~ ^{contaminates} ~~nts.~~

^{Examples} Example of tertiary ~~amino-group~~ ^{amino-group} containing ~~ing~~ compounds having ^{the} above mentioned excellent properties are polyoxyethylene (3-30) octadecyl amine, ~~polyoxyethylene (3-30)~~ ^{polyoxyethylene (3-30)} (3-30) lauryl amine, polyoxyethylene (3-30) oleyl amine, polyoxyethylene (3-30) ~~dilauryl~~ ^{dilauryl} amine, polyoxyethylene (3-30) stearyl amine, polyoxyethylene (3-30) alkyl amine, polyoxyethylene (3-30) dialkyl amine.

The amount of ~~amino-group~~ ^{amino-group} containing compound to 100 parts by weight of the borate ester of polyoxyalkylene is from 0 to 100 parts by weight, ~~favourably~~ ^{and preferably} from 5 to 50 parts by weight and most ^{preferably} ~~favourably~~ from 10 to 30 parts by weight.

Use of ~~the~~ ^a solvent contributes to a lower viscosity of the borate ester of polyoxyalkylene.

As the solvent, there can be used water, methyl alcohol, ethyl alcohol, isopropyl alcohol, butyl alcohol, ~~iso-~~ ^{150 propyl} propyl ether, ether, ethylene glycol, polyethylene glycol, polyethylene ~~di-~~ ^{dimethyl}

methyl ester, diethylene glycol, ~~tri-~~ triethylene
~~ethylene glycol~~, ethylene glycol ~~di-~~ dimethyl
~~methyl ether~~, diethylene glycol ~~di-~~ dimethyl
~~methyl ether~~, diethylene glycol diethyl
 ether, ethylene glycol dipropyl ether,
 triethylene glycol dimethyl ether,
 triethylene glycol monobutyl ether, ~~di-~~ diethylene
~~ethylene glycol~~ diethyl ether, ~~diethylene~~ diethylene
~~ne glycol~~ propyl ether, diethylene glycol
~~col~~ dibutyl ether, dimethyl ether, ~~pro-~~ propylene
~~pylene glycol~~, acetone, methylethyl ~~keto-~~ ketone
~~ne~~, furfural, dioxane, methane sulfonate,
~~diethyl~~ ether, tetrahydrofuran, hexane,
 acetic anhydride, heptane, octane, ~~nona-~~ nonane
~~ne~~, decane, undecane, benzene, toluene,
 xylene, cyclohexane, cyclohexene, ~~dime-~~ dimethyl
~~thyl~~ formamide, dimethyl sulfoxide, ~~hexa-~~ hexamethyl
~~methyl~~ triamide phosphate, acetonitrile,
 N-methyl pyrrolidone, chloroform and
 carbon tetrachloride and ~~the~~ ^{these} solvents
^{can be} ~~are~~ used ^{by} alone or ⁱⁿ combination.

The amount of solvent to 100 parts by
 weight of borate ester of ~~polyoxyalkyl-~~ ^{polyoxyalkylene}
~~ene~~ and ~~amino-group~~ ^{amino-group} containing compound
 are respectively from 0 to 100 parts ^{parts} by
 weight, ^{and preferably} ~~favourably~~ from 5 to 50 parts by
 weight and most ^{preferably} ~~favourably~~ from 10 to 30
 parts by weight.

^{Ingredients} ~~The other ingredient~~ other than ~~amino-~~ ^{amino-group}
~~group~~ containing ~~compounds~~ ^{compounds} and/or ~~solvent~~ ^{solvents}
 may be incorporated ^{into the} to borate ester of
 polyoxyalkylene for the purpose of ^{improving} ~~impr-~~
~~oving~~ the properties of the release
^{agents} ~~agent~~ of the present invention.

As the other ~~ingredient~~ ^{Ingredients}, there can be

used stabilizer^S, neutralizer^S, ~~antioxidant~~^{antioxidants}, ultraviolet absorber^S, light stabilizer^S,
~~lizer~~, antistatic agent^S, lubricant^S, ~~processability~~^{stabilizers},
~~cessability~~ improving agent^S, filler^S,
 dispersing agent^S, coupling agent^S, ~~anti-copper~~^{anti-copper},
~~copper rusting agent~~^S, blowing agent^S, ~~nu-nuclear~~^{anti-forming},
~~clear forming agent~~^S, ~~antiforming agent~~^S,
 deformer^S, ~~colourant~~^{colorants}, pigment^S, ~~dyeing~~^{dyeing},
 agent^S, carbon black, water tree prevent-
 ing agent^S, voltage stabilizer^S, ~~antitrae~~^{anti-tracking},
~~king agent~~^S, organic peroxide, ~~crosslink~~^{crosslinking},
 ing agent^S, disinfectant^S, antiseptics,
~~antimold agent~~^{anti-mold} and ~~antirust agent~~^{anti-rust}

In the present invention, a release agent for metallic mold means ~~the release~~^{a release} agent which is coated on the surface of ~~a~~^a metallic mold used for plastic or gum processing to prevent ~~the~~^{between} adhesion ~~between~~^{between} the metallic molds and plastic molded ~~the~~^{product} the release agent ~~allowing~~^{allowing} the plastic molded ~~product~~^{product} to easily separate from the metallic mold.

The ~~metallic~~^{metallic} molds ~~to~~^{for} which the release agent^{agents} of the present invention ~~is~~^{are} ~~applied~~^{applicable} ~~include those~~^{include those} used for making the parts and structural materials for automobile^S, ~~auto~~^{auto} bicycles^S, ~~tobicycle~~^S, scooter^S, television^S, radio^S, audio equipment, washing machine^S, rice cooker^S, personal computer^S, portable telephone^S, game machinery, building materials, office supplies, stationery, ~~toys~~, sports goods, sports equipment, agricultural ~~to~~^{methods} tools and marine tools by the ~~method~~^{methods} of injection molding, blow molding, ~~compre~~^{compression} molding, slush molding, fluidized bed coating, flat film extrusion ~~proce~~^{processing}

~~sewing~~ and ~~the~~ inflation tubular film
~~process~~ processing

The material of mold may be metal or
~~ceramics~~. ceramic

Plastics and gum which are processed by
using the metallic mold of the present
invention are thermoplastics and ~~thermo-~~
~~setplastics~~ as follows.

As the thermoplastic resin, there can
be used high density polyethylene, high
pressure low density ~~polyethylene~~ ^{polyethylenes} such
as HP-LDPE, EVA, EEA, Ionomer, olefin ~~vin-~~ ^{vinyl alcohol}
~~ylalcohol~~ copolymer, LLDPE, VLDPE, ~~poly-~~
~~propylene~~ (PP), polystyrene (PS), ^{polypropylene (PP)}
acrylonitrile-butadiene-styrene ~~copoly-~~ ^{copolymer (ABS)}
~~mer (ABS)~~, acrylonitrile-styrene copolymer
(AS), acrylonitrile-butadiene copolymer,
acrylonitrile acrylate-styrene copolymer,
polyvinyl chloride (PVC), polyamide, ^{poly methylmethacrylate (PMMA)}
~~methylmethacrylate (PMMA)~~, polyacetal (POM),
aminopolyacrylamide, polyarylate, ~~fluoro-~~ ^{fluorocarbon}
~~carbon~~ resin, polyimide (PI), ^{polyarylenebismaleimide (PABI)}
~~bismaleimide (PABI)~~, polyamideimide (PAI),
polyetherimide (PEI), bismaleimidetriazine
resin (BT), polysulfone, polybutylene
terephthalate (PBT), polyethylene ^{terephthalate (PET)}
~~thalate (PET)~~, polyvinylidene chloride,
polycarbonate (PC), polyvinyl acetate,
polyvinyl alcohol, polyvinyl ether,
polyvinyl formale, modified PPE, modified
polyphenyleneoxide (PPO), ^{polyphenylenesulfide (PPS)}
~~lfide (PPS)~~, polyethersulfone (PESF), ~~poly-~~
^{polyetheretherketone (PEEK)}
~~etheretherketone (PEEK)~~, ^{polyarylsulfone (PAS)}
~~polyarylsulfone (PAS)~~, ^{liquid crystal}
~~polymer~~, polymethylpenten (TPX), ~~liquid crystal~~ polymer
~~polymer~~, silicone resin, natural rubber (N
R), butyl rubber (IIR), ~~acrylonitrile-~~
~~acrylonitrilebutadiene~~

~~butadiene~~ rubber (NBR), chloroprene rubber (CR), styrene butadiene rubber (SBR), butadiene rubber (BR).

As the ~~thermoset~~ ^{thermoplastic} plastic resin, there can be used phenolic resin, urea resin, melamine resin, diallyl phthalate resin, epoxy resin, unsaturated polyester resin, ~~and the~~ ^{and the} like.

The plastic molded products made by using the above mentioned resins are used for the parts and structural ~~mate-~~ ^{materials} ~~rials~~ for automobile, [^]autobicycle, [^]scoo- scooters, [^]television, [^]radio, [^]audio equipment, washing machine, [^]rice cooker, [^]personal computer, [^]portable telephone, [^]game machi- ~~nery~~ ^{machinery}, building materials, office ~~suppli-~~ ^{supplies} ~~es~~, stationery, toys, sports goods, sports equipment, agricultural tools and marine tools.

They are usually prepared by plastic processing methods such as injection molding, blow molding, compression molding, transfer molding, rotating molding, slush molding, inflation tubular film ~~process-~~ ^{processing} ~~ing~~ and extrusion molding.

The release ~~agent~~ ^{agents} of the present ~~inve-~~ ^{invention} ~~ntion~~ ^{are} is prepared using one or more than one kind of borate ester of ~~polyoxyalky-~~ ^{polyoxyalkylene} ~~lene.~~

The release ~~agent~~ ^{agents} may contain ~~amino-~~ ^{amino-group} ~~group~~ containing ~~compounds~~ ^{compounds} and/or ~~solvent.~~ ^{solvents}

The release ~~agent~~ ^{agents} may further contain surface active ~~agent~~ ^{agents}, pigment, ~~dye~~ ^{dyes}, ~~in-~~ ⁱⁿ ~~organic~~ ^{organic} filler, ^{agents} dripping preventable ~~agent~~, ^{agents} precipitation preventable ~~agent~~, ^{agents} antioxidant and ~~deformer.~~

antioxidants

deformers

The release ^{agents} ~~agent~~ may be filled in the aerosol container with propellant.

Coating of the release ^{agents} ~~agent~~ of the present invention ^{onto} ~~on the surface~~ of the metallic ^{molds} ~~mold~~ can be conducted by brush ^{brushing} ~~ing~~, spraying, dipping or contacting the surfaces with a woven cloth or nonwoven cloth which ^{are} ~~are~~ ^{has} ~~been~~ immersed ⁱⁿ ~~with~~ the release ^{agents} ~~agent~~.

EXAMPLE

Now, the release ^{agents} ~~agent~~ for metallic ^{molds} ~~mold~~ ^{used} ~~for~~ forming ~~a~~ plastic molded ^{industrial} ~~product~~ according to the present ~~inven-~~ ~~tion~~ will be described in further detail with reference to ^{specific} ~~Examples~~.

However, it ^{should} ~~should~~ be understood that the present invention is by no means restricted by such specific Examples.

Example 1

Borate ester of polyoxyalkylene expressed by chemical formula (5) was obtained by following synthesis process.

In a 7000 ml flask equipped with three inlet ^{pipes} ~~pipe~~ and displaced by nitrogen gas were charged 146g (1 mole) of triethyl borate $[B(OC_2H_5)_3]$, 1.2g of dibutyl tin dilaurate and 500 ml of benzene.

Subsequently, ^{to} ~~to~~ the solution in the flask ~~was added with~~ 664g (2 mole) of tripropyleneglycol triethylenglycol monomethyl ether and 318g (1 mole) of ^{tripropyleneglycol} ~~tri-~~ ~~propyleneglycol~~ triethylenglycol ^{were added} under stirring ^{conditions} ~~condition~~ to obtain ^a ~~a~~ uniform blended solution.

Subsequently, the solution in the flask was stirred for 13 hours at 95°C under ~~the condition of~~ distillation ^{conditions} to remove ~~a~~ ethanol and benzene as the ~~by~~ ^{by product} product ^{and} to obtain 989g (0.99 mole) of a borate ester of polyoxyalkylene ~~expressed~~ by chemical formula (5).

In a vessel, 100 parts by weight of a borate ester of polyoxyalkylene ~~expressed~~ ^{expressed} by chemical formula (5), 15 parts by weight of triethyl amine and 10 parts by weight of ethanol were blended for 10 minutes ~~under~~ ^{at} room temperature to obtain the release agent (1).

The release agent (1) was brushed ~~on~~ ^{onto} the surface of ^a metallic mold for ~~injection~~ ^{injection} molding of polyacetal (POM) resin composition (made by Polyplastic Company Ltd.).

Using above mentioned metallic mold and resin composition, injection ~~mold~~ ^{molding} was conducted.

The ~~terms of maintaining~~ ^{time period over which} the release agent remained ~~effective on the surface of~~ ^{effect on the surface of} the metallic mold was about 55 hours, ~~the terms which~~ ^{this effective time period} was very long ~~com-~~ ^{as compared} ~~paring to~~ ^a conventional release agent as shown in ~~the~~ comparative example 1.

The words ~~"The terms of maintaining the release effect of the metallic mold"~~ ^{term "effective time period"} means the ~~terms~~ ^{period} from starting time to stopping time of injection ~~mold~~ ^{molding} ~~with the~~ ^{being} stopping time which ~~is~~ ^{at which} the time of ~~being~~ ^{the following} observed any one item of phenomena are observed: such as accumulating of dirty materials on the surface of metallic mold; ~~cloud~~ ^{clouding} ~~ing~~ of the surface of the metallic mold;

~~transferring~~ ^{transferring} the shape ~~or contaminant~~ ^{contaminants}
from the metallic mold to the plastic
molded product; or ~~transferring~~ ^{transferring} contaminants from the metallic
mold to the plastic molded product

Comparative Example 1

According to the same preparation
method of Example 1, a release agent (2)
consisting 100 parts by weight of high
viscosity silicone oil (500 cs at 25°C) and
20 parts by weight of the chlorinated
type solvent was prepared.

~~The same releasing test was conducted~~ ^{this release agent was tested}
according to ~~the same condition of ex-~~ ^{procedure as Example 1.}
~~ample 1.~~

~~The terms of maintaining the release agent on~~ ^{effective time period of this}
~~effect of the metallic mold of compara-~~
~~tive example 1 was about 10 minutes.~~

Example 2

Borate ester of polyoxyalkylene
expressed by chemical formula (8) was ~~pre-~~
prepared according to the same preparat-
~~ing method (1)~~ ^{was used} except using pentaethylene-
glycol ethylether instead of tripropylene-
~~neglycol triethyleneglycol monomethyl~~ ^{tripropylene glycol}
ether and tripropyleneglycol triethylen-
glycol.

~~Then a release agent (3)~~ ^{Then a release agent (3)}
~~Then, a release agent (3)~~ ^{polyoxyalkylenes} consisting 100
parts by weight of borate ester of poly-
oxyalkylenes expressed by chemical
formula (8) and 20 parts by weight of the
pentaethyleneglycol was prepared.

~~The same releasing test was conducted~~ ^{this release agent was tested}
according to ~~the same condition of~~

^{procedure as}

example 1. ^{effective time period of this}
The ~~terms of maintaining the release agent~~
~~effect of the metallic mold~~ ^{on the metallic mold}
~~effect of the metallic mold of example 2~~
was about 48 hours. ^{this effective time period}
~~the terms which~~ was
very long ^{as compared} to ^{the} conventional
release agent ~~as~~ shown in ~~the~~
comparative example 1.

Example 3

Borate ester of polyoxyalkylene
expressed by chemical formula (14) was
prepared according to the same preparat-
~~ing method~~ ^{except using pentacosaeethylene}
~~glycol~~ ^{was used} instead of ~~tripropylene glycol~~
~~or triethyleneglycol monomethyl ether and~~
~~tripropylene glycol triethylen glycol.~~

Then, a release agent (4) consisting 100
parts by weight of borate ester of ~~poly-~~ ^{polyoxyalkylene}
~~oxyalkylene~~ expressed by chemical
formula (14) and 20 parts by weight of
the polyoxyethylene (9) dilauryl amine
was prepared..

^{this release agent was tested}
~~The same releasing test was conducted~~
according to the same condition of ex-
ample 1. ^{effective time period of this}
^{proceedure as}

The ~~terms of maintaining the release agent~~
~~effect of the metallic mold~~ ^{on the metallic}
~~effect of the metallic mold of example 3~~
was about 65 hours. ^{this effective time period}
~~the terms which~~ was
very long ^{as compared} to ^{the} conventional
release agent as shown in ~~the~~ ^{comparative}
~~example 1.~~

ABSTRACT

A release agent for metallic mold for forming a plastic molded product characterized by containing a borate ester of polyoxyalkylene.